ARTIFICIAL AQUIFER RECHARGE FOR MANAGING WATER RESOURCES IN THE POTOMAC AQUIFER

POTOMAC WATERSHED ROUNDTABLE

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Clear Creek Associates

- ~35-person firm founded in 1999
- Hydrogeologic studies
- Water wells / water supply
- Artificial recharge (AR) /aquifer storage & recovery (ASR) projects
- Groundwater withdrawal permitting
- Environmental investigation and remediation
- Groundwater modeling

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Objective

- Discuss the potential use of artificial aquifer recharge to address Coastal Plain water resources issues (including the Potomac aquifer).

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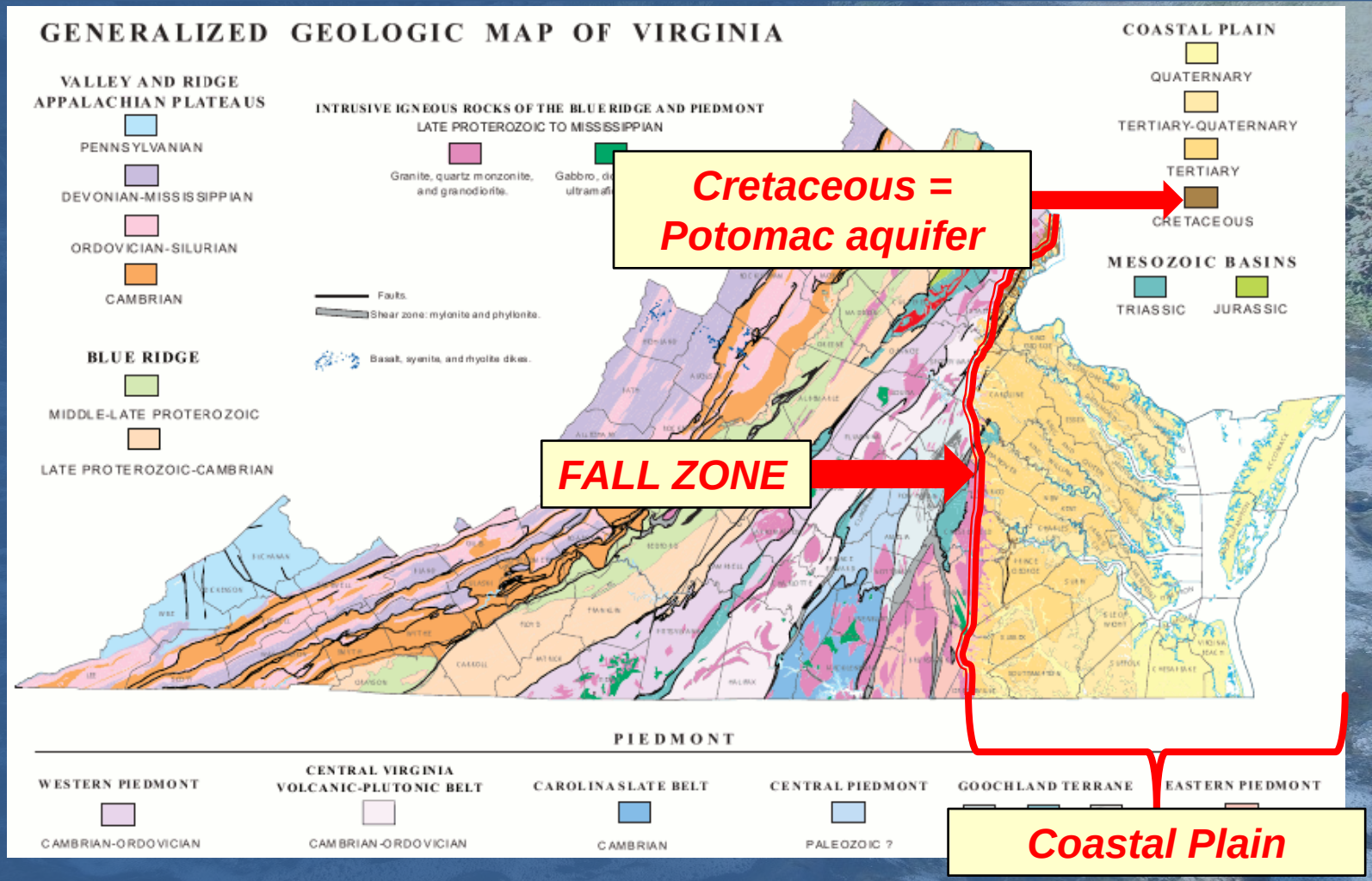
Background



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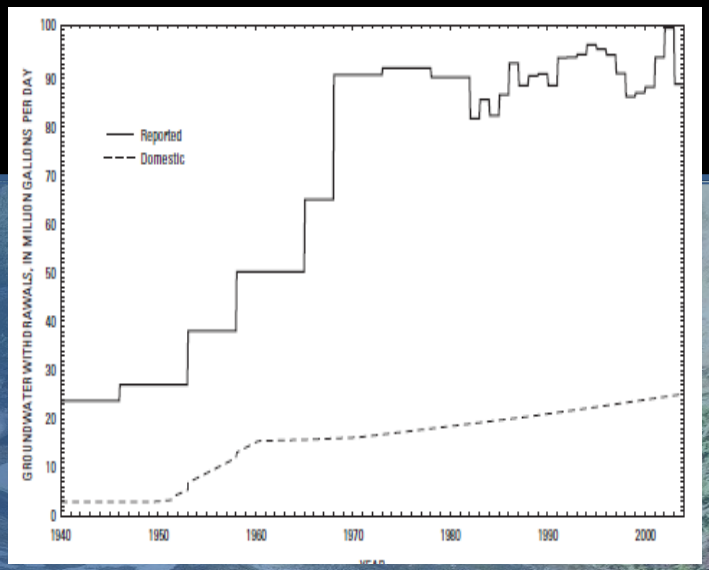
Issue

- Since 1940, GW withdrawals in the Virginia Coastal Plain have increased by over 4X
- GW withdrawals have lowered water levels in the Potomac aquifer by ~200 feet in some areas = less water, saltwater intrusion
- DEQ began issuing groundwater withdrawal permits in early 1990s and expanded Eastern VA GWMA to help address issues
- GW in deep aquifers such as the Potomac naturally recharge very slowly (>1,000 years)
- EPA requiring actions to reduce water pollution in local streams and rivers in connection with EPA's Total Maximum Daily Load to restore the Chesapeake Bay



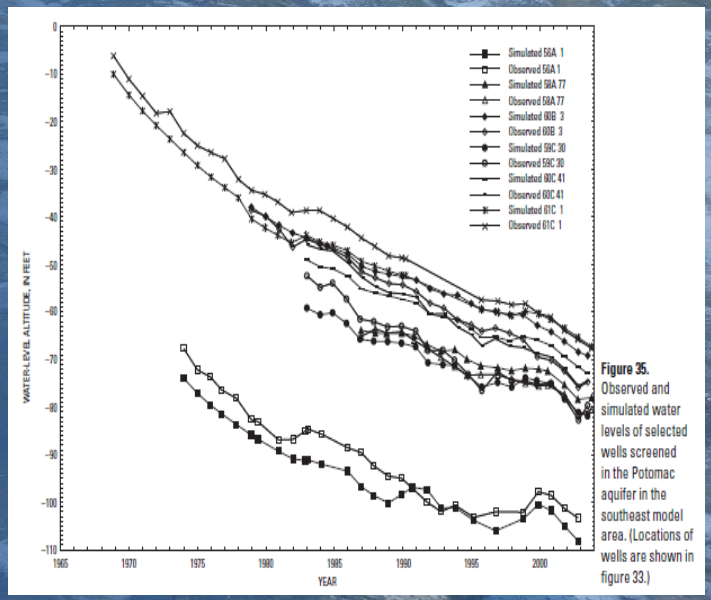


Figure 35. Observed and simulated water levels of selected wells screened in the Potomac aquifer in the southeast model area. (Locations of wells are shown in figure 33.)

Heywood & Pope, 2009: USGS SIR 2009-5039

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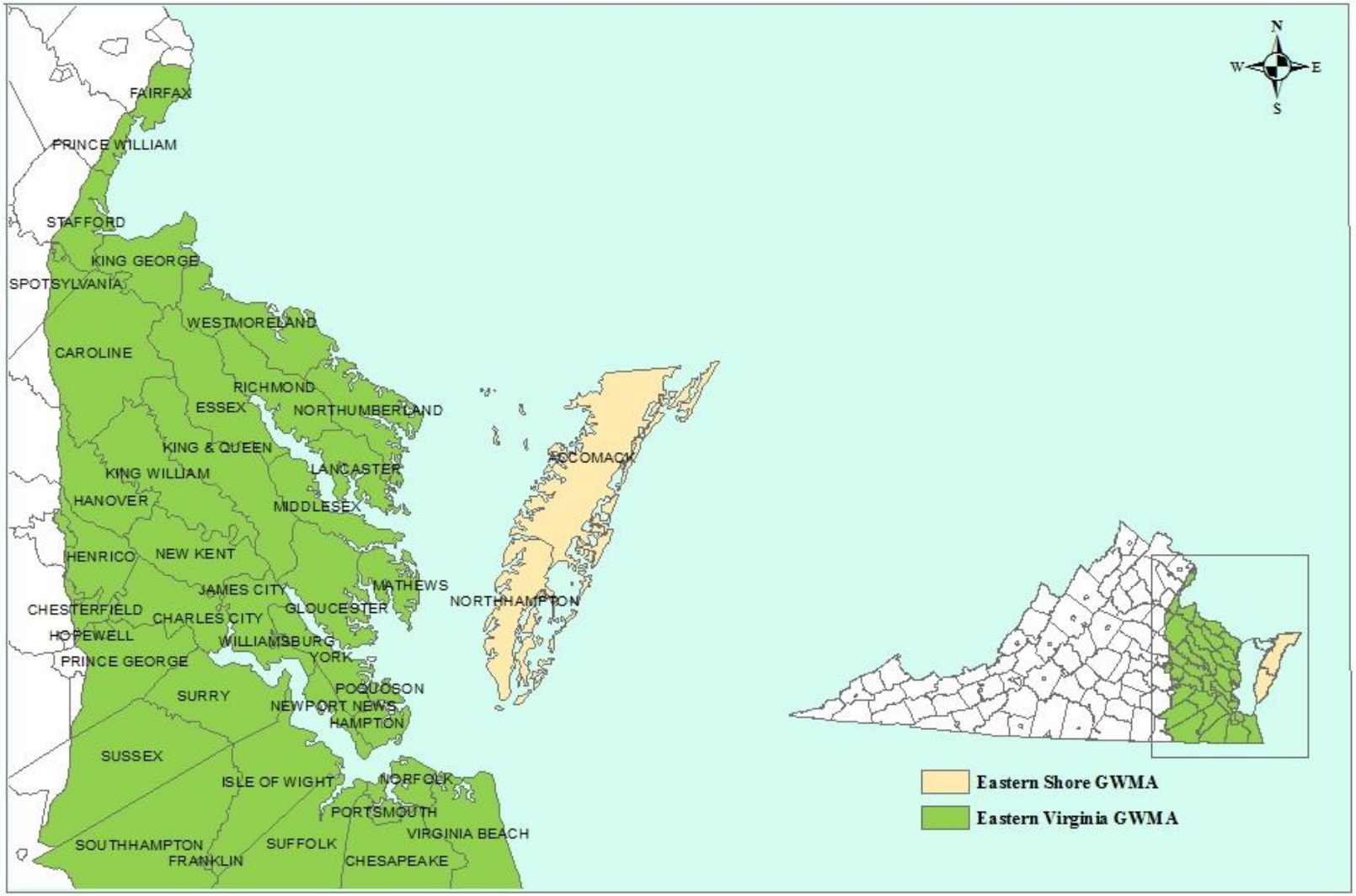
COMMONWEALTH OF VIRGINIA
GROUNDWATER MANAGEMENT AREAS (GWMA)



Effective: January 1, 2014
Prepared By: Virginia Department of Environmental Quality
Groundwater Withdrawal Permitting Program

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

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Potomac aquifer water levels – before & after

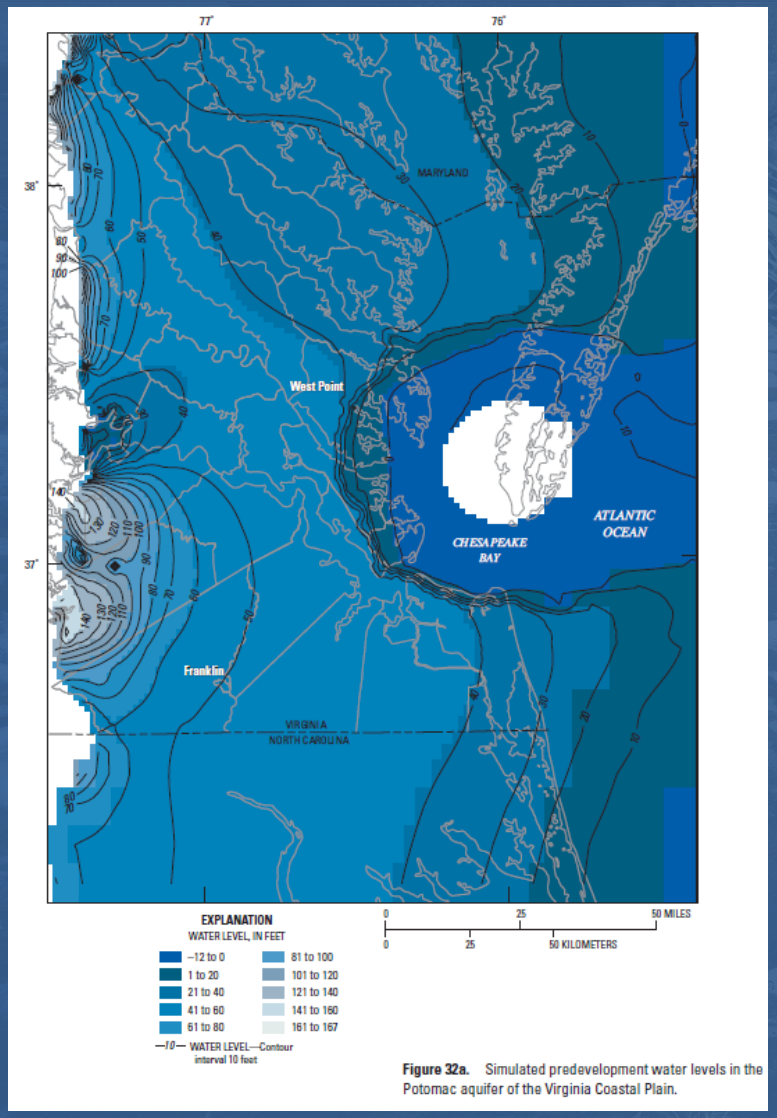

Figure 32a. Simulated predevelopment water levels in the Potomac aquifer of the Virginia Coastal Plain.

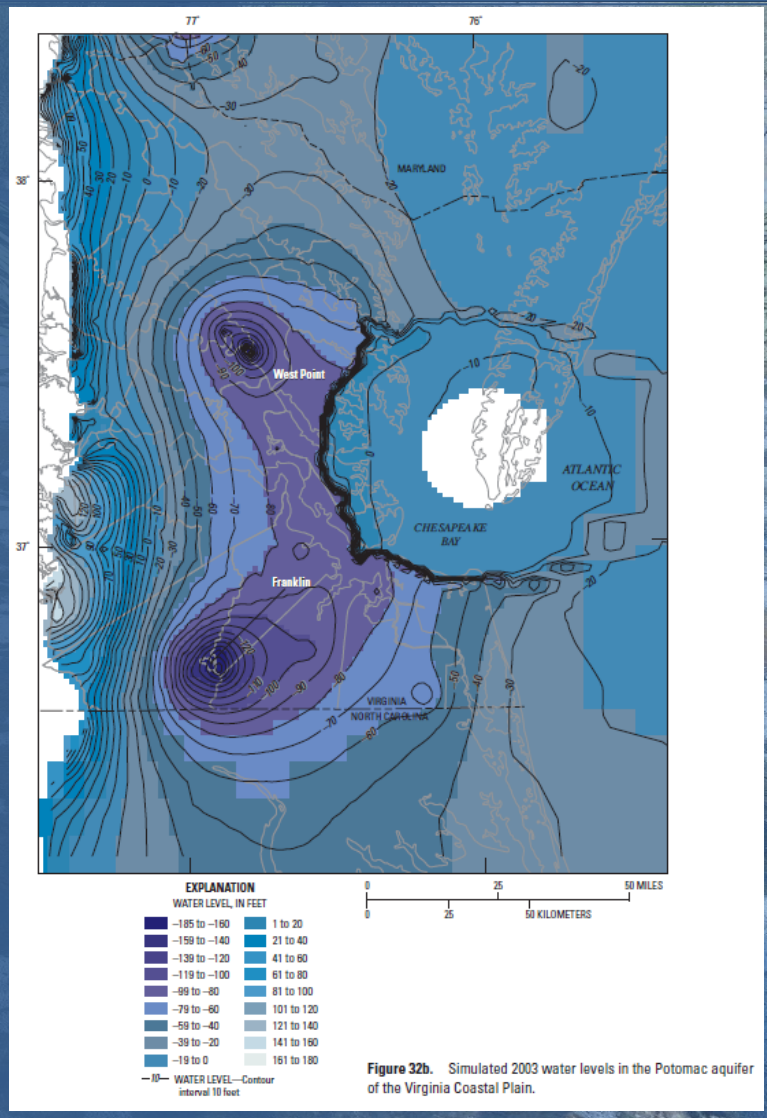

Figure 32b. Simulated 2003 water levels in the Potomac aquifer of the Virginia Coastal Plain.

Heywood & Pope, 2009: USGS SIR 2009-5039

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Surface Water Analogy – Lake Mead (Colorado River) Water Levels

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Artificial Aquifer Recharge

- Artificial aquifer recharge (AR) is the enhancement of natural ground water supplies using man-made conveyances such as infiltration basins or injection wells.
- Water sources can include:
  - Surface water
  - Treated waste water
- Where is AR being conducted?
  - Southwest US, CA, OR, NJ, PA, DE, FL, GA.
  - Chesapeake, Virginia (since early 2000s)

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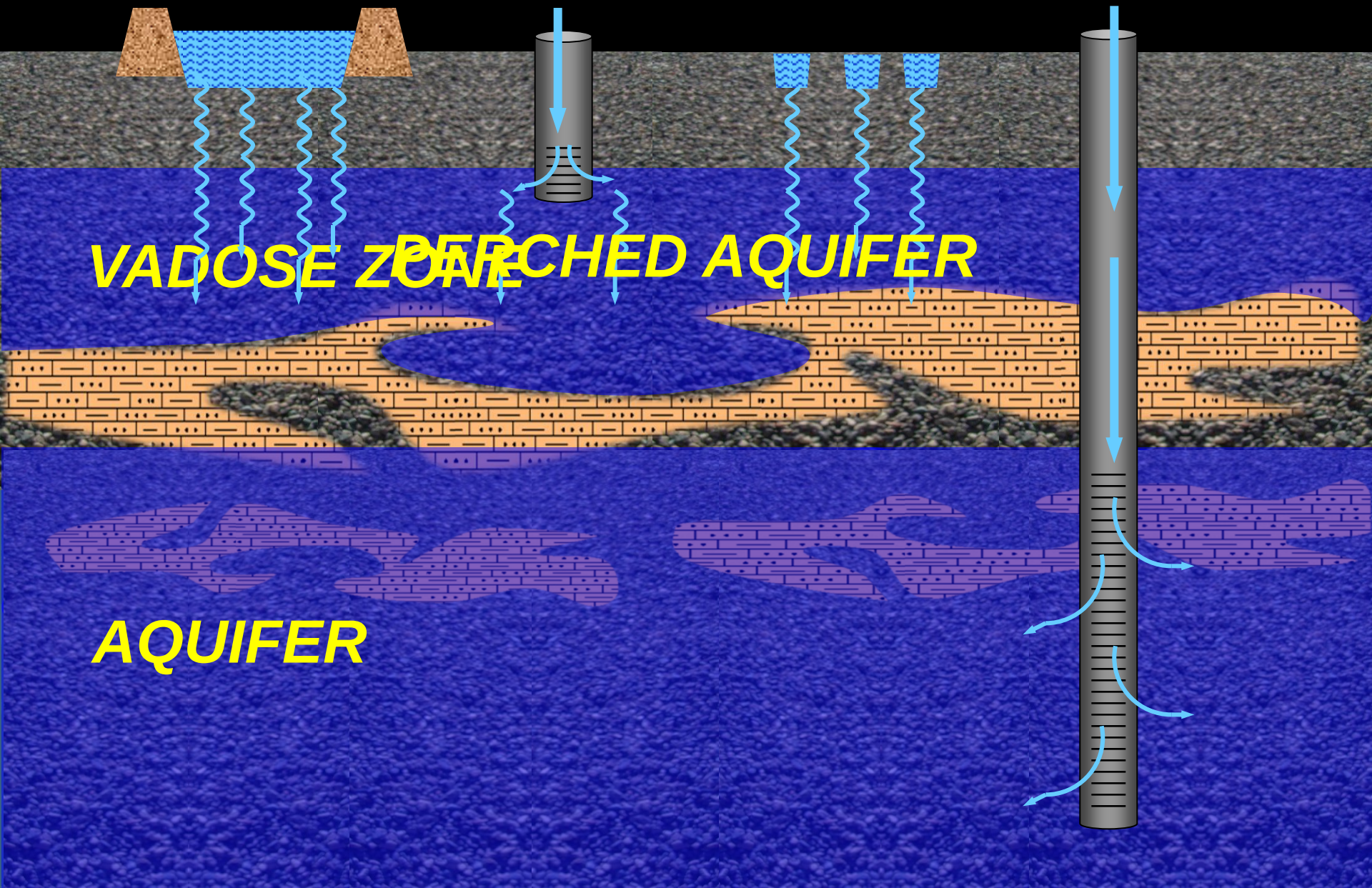
Primary Recharge Methods



Artificial Aquifer Recharge

- Considerations
  - Is there a sufficient and sustainable source of water for aquifer recharge (e.g., stormwater, treated wastewater)?
  - If treated wastewater, what will be the impact on groundwater quality?
  - Is it technically feasible (are aquifer conditions sufficient to accept recharge water)?
  - Are groundwater users/consumers/public ready to accept/support the reinjection of stormwater or treated wastewater into drinking water aquifers?
  - How would reducing surface water discharges affect streams/rivers?
  - How much would AR cost to implement and who pays?
  - Would AR address the Coastal Plain/Potomac aquifer overdraft issue?

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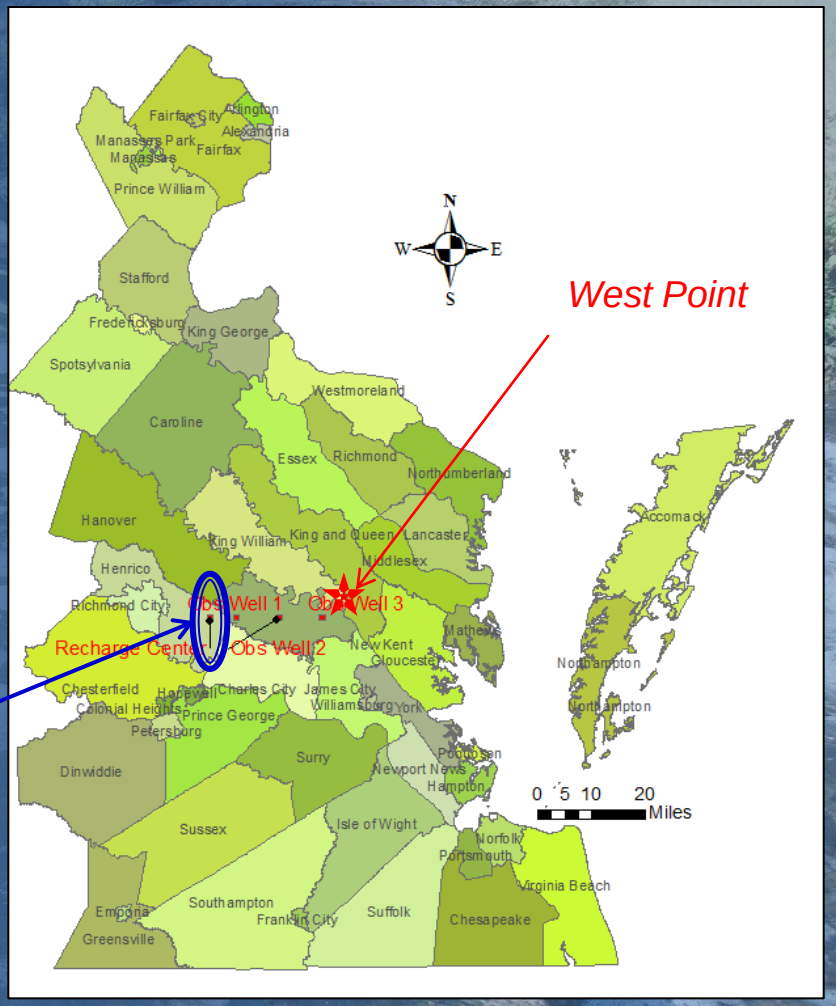
AR Simulation Using DEQ's VAHYDRO-GW Flow Model

- Simulated 10 MGD AR Facility Near Fall Line.
- AR through three injection wells in Potomac Aquifer.



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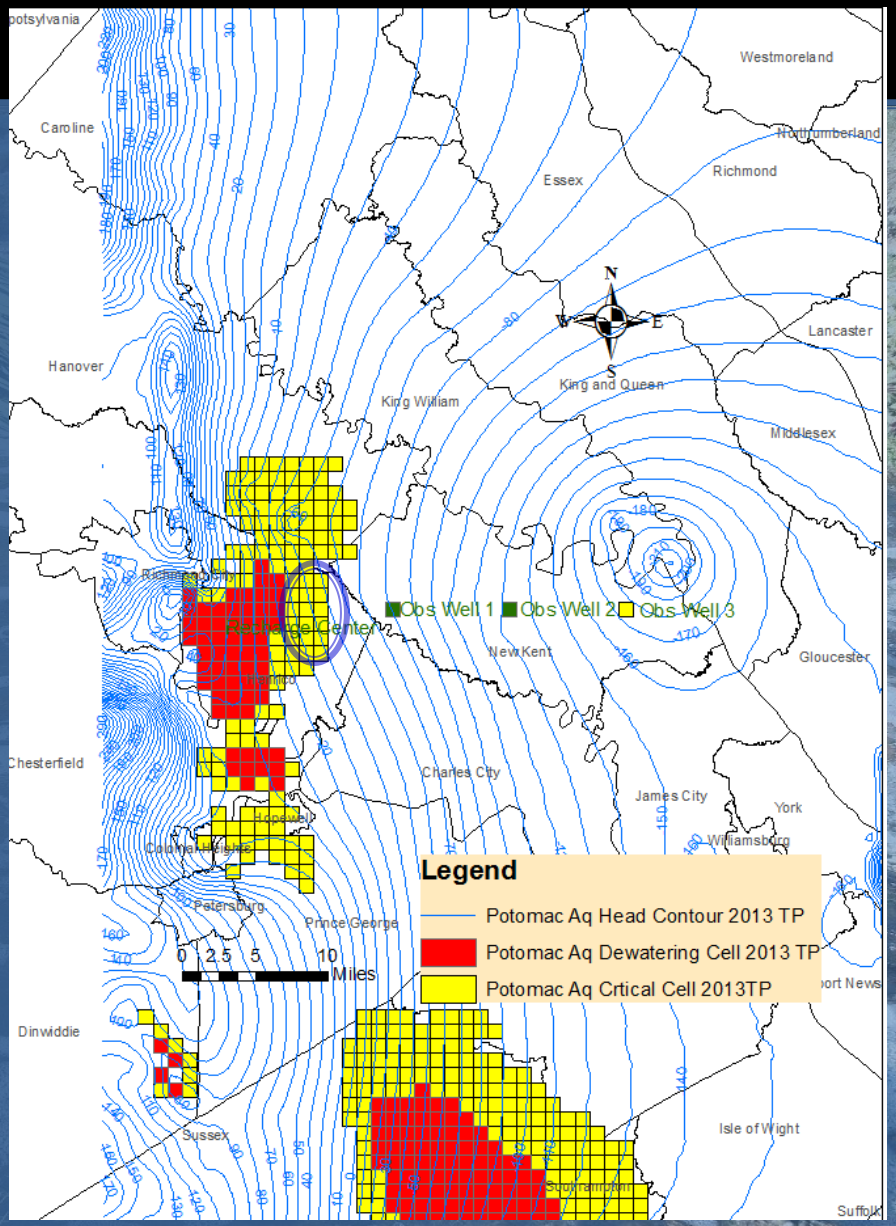
Base Case

- 50-year (2013-2062) predictive run. No AR simulated.
- Potomac Aquifer predicted heads year 2062.



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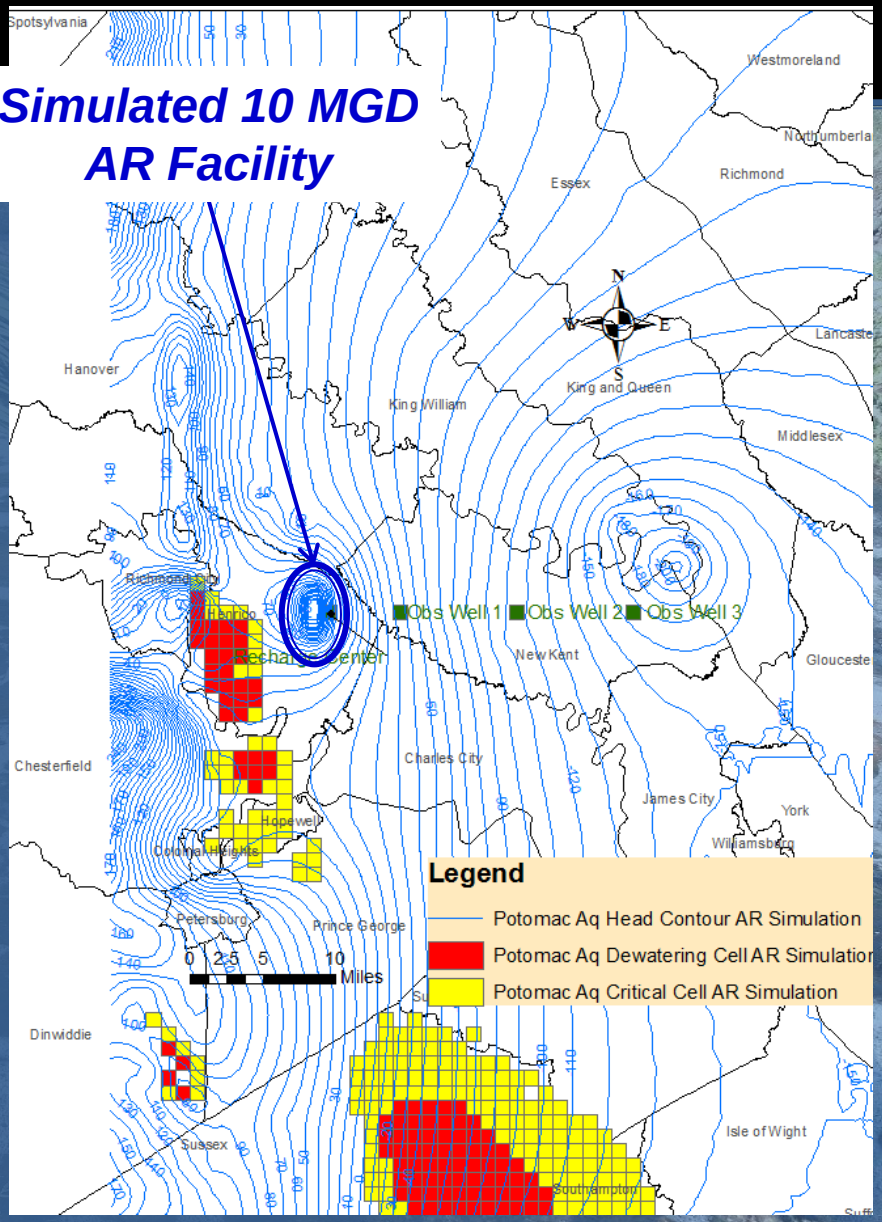
AR Simulation

- 50-year (2013 – 2062) predictive run.
- 10 MGD AR.
- Potomac aquifer predicted heads in year 2062.



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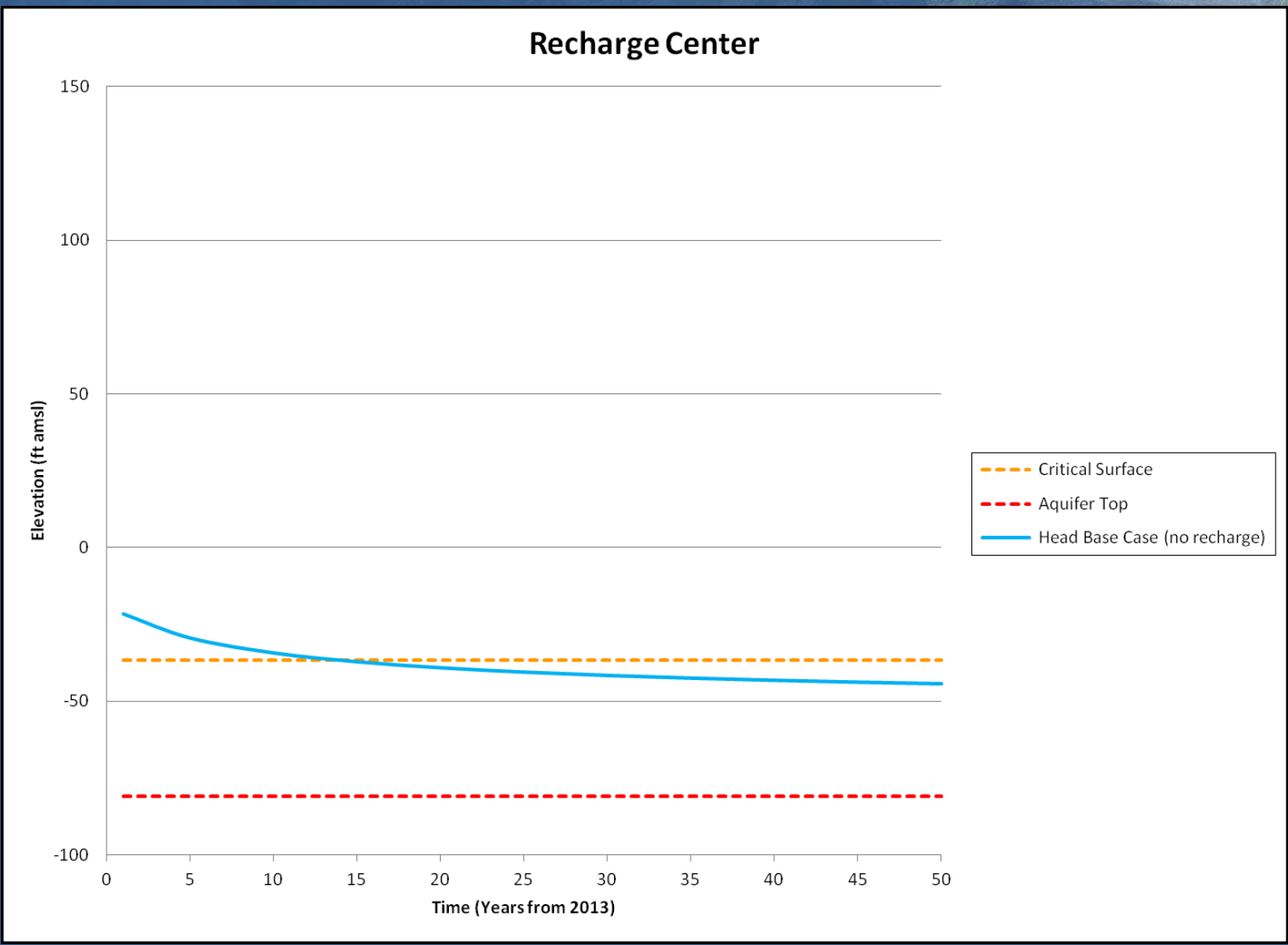
Predicted Head Elevations – Potomac Aquifer



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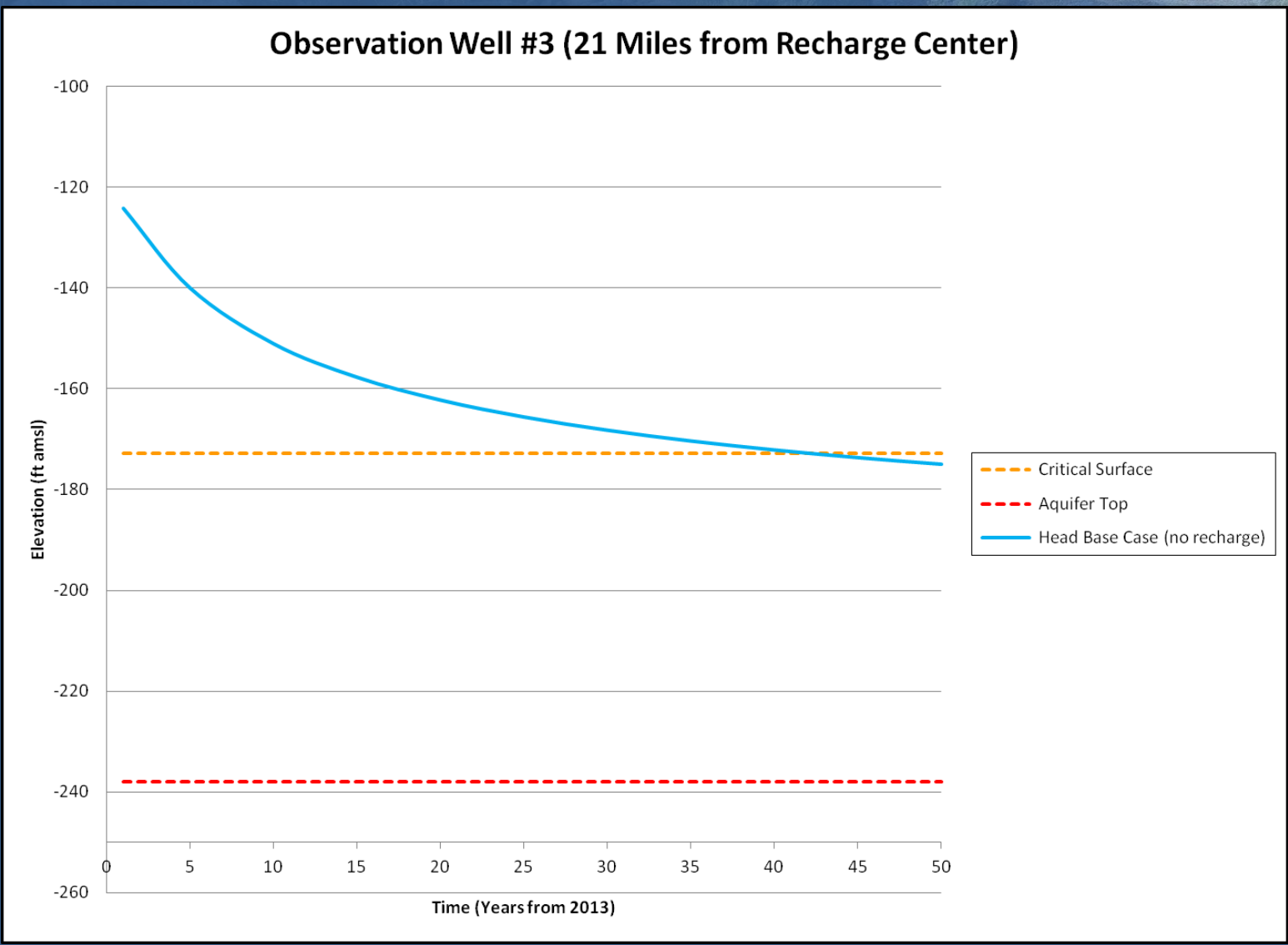

Potential Benefits of AR

- Reduce critical aquifer surface areas along the fall zone and western Coastal Plain, allowing for future GWWPs to be issued for entities in these areas
- Reduce and reverse saltwater intrusion, thereby improving overall groundwater quality
- Allow VPDES permit holders to reduce nutrient discharges to Chesapeake Bay and its tributaries, thereby reducing treatment costs while helping clean up the Bay
- AR projects may be collaborative and consist of public-private partnerships, pooling of economic resources, and possible trading options (similar to nutrient credit trading)

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EPA and DEQ Regulatory Authorization/Permitting Process

- Clear Creek recently completed a study for Hanover County focusing on how DEQ and EPA would review and authorize an AR project
- Held meetings with EPA Region III Underground Injection Control (UIC) and DEQ Groundwater Withdrawal Permitting Staff

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DEQ – AR Authorization Process

- DEQ could review and permit an AR project through the Groundwater Withdrawal Permit (GWWP) process
- Water quality monitoring, point-of-compliance (POC), and a mitigation plan would likely be required as part of the permit
- GW withdrawal and AR injection rates/volumes need not balance
- Injection pilot testing could be authorized as a Special Exception

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EPA – UIC Program Authorization Process

- AR Injection well would be classified as a Class V UIC injection well
- EPA would compare the injection (treated WW effluent) water quality to national DW standards with a focus on common municipal WW constituents (microorganisms and nitrate)
- If UIC/Safe Drinking Water Act (SDWA) requirements are met, EPA would issue a notice that the project is authorized by rule
- EPA has authority to require an individual permit (including public participation), but does not issue individual permits for Class V UIC wells

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Summary

- Groundwater use in the Potomac aquifer and other Coastal Plain aquifers is currently over-allocated.
- Preliminary modeling analysis using DEQ's VAHydro-GW model suggests AR could alleviate head declines in the overstressed Potomac aquifer.
- Three AR wells injecting a total of 10MGD resulted in a reduction of 139 Critical Cells (139 square miles) and a reduction of 44 "Dewatered" cells (cells where the TP simulation predicted head below the aquifer top).
- This conceptual analysis did not consider economic and technical issues associated with implementing an AR project in the Virginia Coastal Plain.
- An AR project would be authorized by DEQ (GWWP) and EPA (UIC authorization-by-rule)

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QUESTIONS?